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ABSTRACT

An overview of the research on the cognitive effects of higher education is presented. It is suggested that studies exist on three levels: (1) measurement of the increment of specific factual knowledge; (2) understanding the basic concepts in a certain area, studied by qualitative analysis; and (3) the development of awareness of the nature of scientific knowledge. Topics include the following: students' knowledge outside their major field of study; the long-term retention of course material; students' developing conceptions of knowledge (Perry, 1968); students' views on biological evolution (Brumby, 1979); students' conceptions of everyday economic phenomena such as prices, wages, and inflation (Dahlgren, 1978); and dimensions of cognitive functioning (communication, analytic thinking, synthesizing ability, awareness) (Warren, 1976, 1978). (SW)

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HIGHER EDUCATION - IMPACT ON STUDENTS

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HIGHER EDUCATION - IMPACT ON STUDENTS

The question of the impact of higher education upon students has attracted intense and quantitatively impressive interest since the 1930's. The intention in the following is to give an overview of the outcome of those parts of that research tradition which have been devoted to the cognitive effects of higher education.

The attempts to describe the cognitive outcome of university education have been made by applying various instruments designed to illuminate the phenomenon at various levels and by exploring many different content areas. The overwhelming majority of the research has been carried out in the United States, where most of the instruments have also been developed. Hence, the available research overviews in the area have also mostly been written by American authors (Feldman & Newcomb, 1969; Astin, 1977; Pace, 1979). Although some longitudinal studies exist, a major part of the research is made up of cross-sectional investigations or one-point-measurements of freshmen, graduates or alumni. The instruments applied were preferably standardized achievement tests, most of them developed for use in the system of higher education i.e. designed to fulfil an internal evaluational function. Aptitude tests and self-report scales on e.g. cognitive interests and development have also been used to some extent. There are relatively few examples of interview studies or open-ended questionnaires. The few existing studies utilizing methods oriented more towards so-called "soft" data have usually aimed at describing effects on levels other than the mere increment of facts during university education.

Since most studies of the cognitive impact of university studies on students have been centered upon the growth of factual knowledge it is natural to start by reviewing some of this work. It is tempting to begin by quoting a few lines from Pace (1979) when summarizing the overall picture given by findings in this area:

> *Do students learn anything in college? Yes. Do they themselves believe that they have made progress toward such ends as critical thinking, acquiring a body of facts and knowledge of a special field, personal and social development, tolerance, broadened literary acquaintance, and so on? Yes. (ibid p 5)*

The conclusion that e.g. students taking courses in chemistry know more chemistry afterwards then before is obviously not very surprising. The magnitude of the increment of factual knowledge shows a surprisingly high degree of constancy between the numerous investigations. It seems as if the gains in most areas are of the order of one third of a standard deviation of the measurement or 15-25 per cent. An important question that has received a lot of attention is therefore that of what happens to students' knowledge outside the field they specialize in. When comparing the gain for students majoring in different subjects it appears that those who major in fields that also yield skills in special areas, such as mathematics (e.g. students of engineering and natural science) gain in other areas as well (humanities, social science) whereas students in modern languages, humanities and social sciences gain in all areas except mathematics.

Another difference between students in different areas that emerges in several studies is that the relative difference between the groups in their own field and other fields is that the performance of natural science students in their field and that of other students is always greater than the differences between the performance of students majoring in social science and humanities in their fields and students majoring in other subjects. This implies that the special character of the content of natural science courses makes it difficult to acquire by means other than taking formal courses in them. It may well be that students of natural science or engineering may undergo a development in humanities and social science by their extra-curricular reading in these areas. It also seems to be the case that investigations of the aptitude level of students when entering as well as graduating from higher education generally place students of engineering, medicine, and natural science in the top ranks. (Centra 1965, Thislethwaite 1963, Pace 1964).

These results raise the critical question of wheter these effects are of an enduring character. So far very few investigations have dealt with this issue. The few that exist (e.g. Bach & Saunders 1965 and Gustav 1969) point to a relatively dramatic deterioration. In the first study, teachers of economics with and without formal education in economics were tested on an achievement test. The results showed no significant difference in performance except for a moderate tendency when those without any courses in the subject were compared with those who had taken at least five terms of courses in economics. In the latter study advanced students of psychology

who had taken their courses in psychology between 0.5 - 22.5 years ago were tested on an instrument made up of items from elementary courses. About forty per cent of the subjects managed to answer more than sixty per cent of the questions. There were no significant correlations between the length of the interpolated time and the performance on the test or between the earlier grades on the courses and the test result. Due to the limited number of studies about the long-term retention of course materials special caution is necessary in drawing any conclusions. It seems however, reasonable to assume that in quantitative terms the impressive short-term efficiency in outcome in respect of specific factual knowledge in higher education must be revised if the interval between the termination of the studies and the measurement is expanded to several years.

If the impact of higher education on students is investigated on levels other than the growth of factual knowledge, the investigations to hand are commonly of another methodological character than those mentioned above. Perry (1968), by means of recurrent semi-structured interviews explored students' conceptions of knowledge. Perry's analysis of the longitudinal data resulted in a sequence of development consisting of three main stages - each one in its turn comprising three distinct substages - through which a majority of the subjects appeared to progress. (The substages represent gradual development from one main stage towards the next).

The three main stages can be characterized according to the following:

Position 1. Basic duality. The core of this conception is a kind of polarity in terms of "right" or "wrong". A statement is either right or wrong, otherwise it is not worth considering. The function of education in a person's life is consequently regarded as an opportunity to learn more right answers to various questions about how things "really are".

Position 4. Relativism subordinate. When classified at this stage a student perceives knowledge as contextual and therefore as relativistic. Phenomena can be looked upon from various perspectives and hence be described or explained in different ways.

Position 9. Developing commitment. Characteristic of this stage is the realization of commitment as an ongoing, unfolding activity through which the student expresses his "life style".

Perry's work represents the recent tendency towards a greater interest in the meta-effects of higher education. The results of investigations examining impact on this level seem to indicate that the degree and level of awareness of concepts, such as scientific knowledge, learning etc are to be affected.

Perry's work might be seen as embodying a concern with the development of generative concepts, since students' conceptions of e.g. scientific research, knowledge, and learning ought to have, we might reasonably assume, a decisive influence on the strategies chosen in their academic work.

In a sense, the factual knowledge and the meta-conceptions of e.g. knowledge can be regarded as two extreme levels of possible and observable effects of formal education. Between these two there is however, a third identifiable level where an impact may be observed. The special character of this level, which warrants a separate interest in an intermediate level is constituted by its methodological similarities with e.g. Perry's investigation, whereas the choise of content coincides with the interest in specific elements from various scientific disciplines although the attention has been focussed on basic concepts of high centrality.

Brumby (1979) presented a set of questions posing problems about evolution in its biological sense, to a group of post A-level Biology students. The overall result indicates that only a small proportion of the students (15%) showed a good understanding of the concept of evolution. Even more significant from both methodological and theoretical viewpoints is the fact that what is typical of a Lamarckian conception of evolution was the most common way of explaining the problems presented.

> *In doing this students failed to appreciate the difference between changes acquired during the lifetime of an individual, and changes in the proportions of individuals with certain characteristics in populations, occurring over many generations. (Brumby, 1979, p 123)*

The significant difference between the Darwinian conception of evolution - which is the accepted one at present - and the Lamarckian is that the change in the former is brought about by the selection of a spontaneously occurring variation among specimens of a species, whereas in the latter the change is created by the inheritance of individual specimen's adaption.

In a study that shows several methodological similarities with Brumby's, Dahlgren (1978) interviewed students of Economics in two recurrent interviews at the beginning and at the end of their first term of university studies, about their conceptions of everyday-life economic phenomena such as prices, wages, inflation etc. Through a qualitative analysis of the answers, a set of categories was identified that could be used for describing the variation both between and within individual subjects.

The results show that the change between categories from the first interview to the second, both on individual and group levels, is very marginal. The most tangible changes instead appear on the language level, where an increase of economic jargon is clearly noticeable. This change of vocabulary does however not indicate other ways of apprehending economic phenomena.

A strongly related kind of research is the recent work by Warren (1976, 1978) where four major dimensions of cognitive functioning were identified from the answers to an inventory among faculty members in a number of disciplines. These dimensions were:

Communication: Clarity and precision of written expression; ready movement from one mode of written expression to another.

Analytic thinking: Identification of the essential components of ideas, of inconsistencies and inaccuracies in the statement of ideas; discrimination of fact from conjecture, the important from the unimportant, relevant from the irrelevant.

Synthesizing ability: Generalization of ideas to new or broader contexts; integration of given knowledge or information into more general structures.

Awareness: Sensitivity to the implications of thoughts and actions for the social good, and to the importance of values and cultural contexts in human affairs. (Warren 1978, p 13)

Sixty questions were then constructed aiming at measuring the development in the four aspects. The similarities with the work carried out by Warren, which is in progress, and the two investigations in Economics and Biology mentioned earlier is the lack of a priori constructed categories for analysis of the answers. It remains to be seen whether Warren's results will support the rather pessimistic picture obtained in Dahlgren's and Brumby's studies or whether further support of Perry's findings will be achieved.

There are, according to the description made hitherto, studies available for identifying the impact of higher education on three

different levels: measurements of the increment of specific factual knowledge, within as well as outside the field of study chosen by the subjects investigated; understanding of basic concepts in a certain area, studied by qualitative analysis; and the development of awareness of the nature of scientific knowledge. The most positive picture of the impact is definitely on the first level, whereas the permanency of these effects could be seriously questioned, to judge from the relatively few investigations on this question. A positive development in terms of the growth of sophistication on topics related to level three can also be traced, although not all students seem to pass through the three main stages described by Perry (1968). The most discouraging results seem to stem from investigations focussing on effects on the second level, i.e. understanding of basic concepts.

There are several possible explanations of these rather counter-intuitive results. The most obvious reason would be that the investigations on the second level are of an external character in relationship to the explicit content of the courses. The issues brought to the fore are often seemingly trivial, and lack the complex and sophisticated character of examination test items incorporated in the internal evaluation of the teaching. On the other hand they often strain the students' understanding of very profound concepts in a way that makes it impossible to answer them by the application of algorithmic procedures for problem solving that may not necessarily indicate understanding, or by eliciting a fluency of sometimes rote-learned elements of professional vocabulary. This indicates

that a substantial part of the cognitive effects of higher education may be local i.e. contextual in the sense that they are associated with the specific examples and situations through which they have been promoted in teaching. It also suggests that if we wish to understand the more enduring aspects of the impact of higher education on individuals, we shall have to intensify research efforts to illuminate what students really learn rather than measuring how much they remember of the actual content of their education.

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